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# A Review on Mobile Cloud Computing

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**ABSTRACT:** Mobile computing and cloud computing is combined to get a new paradigm called Mobile cloud computing. It uses cloud computing to deliver applications to mobile devices. These mobile apps can be deployed remotely using speed and flexibility and development tools. Mobile cloud applications can be built or revised quickly using cloud services. They can be delivered to many different devices with different operating systems, computing tasks, and data storage. This paper will be useful for anyone who are interested about Mobile cloud computing. In this paper, we have described about Cloud computing, its architecture and characteristics. The concept of load balancing used in MCC is also discussed. At the last, the results analysis is given on the basis of two parameters named as energy consumption and resource utilization for different load condition.

**KEYWORDS:** Mobile cloud computing, Architecture, Mobile Computing, Data security, Load balancing.

## I. INTRODUCTION

People have always seen the dream of using the computing resources as a utility such as water, electricity, telephone and gas etc. ever since the first computer was developed. Cloud computing is the one of the most promising technology to convert these dreams into reality. Cloud computing provides on-demand, scalable, device-independent and reliable services to its users.

The aim of mobile cloud computing (MCC) is to use cloud computing techniques for storage and processing of data on mobile devices, and hence to reduce their limitations. The term MCC was introduced just after the concept of cloud computing that was launched in mid-2007. Since then, it has been drawing attention of organizations to reduce the development cost of mobile applications. It provides the mobile users and researchers a variety of mobile services at low cost. Here, we discuss the technologies that have led to the development of MCC[1].

## II. ARCHITECTURE OF MOBILE CLOUD COMPUTING

Mobile cloud computing is a new platform combining the mobile devices and cloud computing to create a new infrastructure, whereby cloud performs the heavy lifting of computing-intensive tasks and storing massive amounts of data.

In the new paradigm of MCC, we can view the computing model as a virtual-physical interactive model, where the virtualized system and the physical system interactively provide services to each other. MCC relies on sharing of resources from Internet clouds, and neighboring mobile, sensing, computing, and storage devices, to achieve coherence and economies of scale, break barriers among different service communities, similar to a utility (like the electricity grid), however, over a heterogeneous networking environment[3].

In this new architecture, data processing and data storage happen outside of mobile devices. MCC enables mobile users to store/access large data on the cloud. MCC helps to reduce the running cost for computation intensive applications. Big companies such as Amazon are in the distance in mobile groups whereas small-scale organizations are members of proximate immobile computing entities.

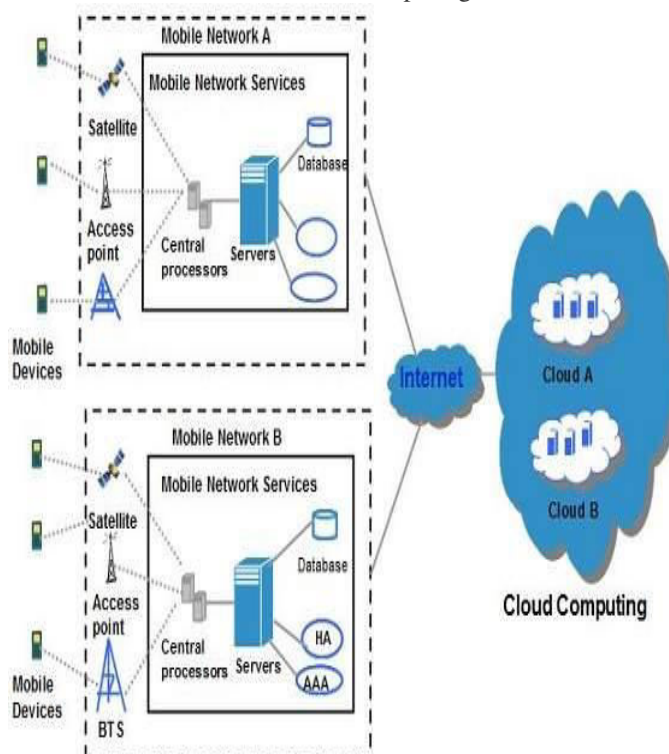
To execute mobile application there is a need for several factors which are the availability of the local resource, user requirement, service level agreement, and faster network availability.

Remote storage is a part of mobile Cloud Computing in which the data can store and retrieve with the help of mobile phone. The storage in mobile phone gets completely utilized if the data is stored on the mobile phone. So, with the help of remote storage, the data can be uploaded in the cloud and the storage of the mobile can be utilized for another purpose.

MCC includes five types of cloud resources:

- Distant mobile cloud
- Distant immobile cloud
- Proximate mobile computing entities
- Proximate immobile computing entities
- Hybrid[2].

The following diagram shows the framework for mobile cloud computing architecture:



### III. CHARACTERISTICS OF MOBILE CLOUD COMPUTING

The following factors are fostering the adoption of mobile cloud computing:

- Trends and demands: customers expect the convenience of using companies' websites or application from anywhere and at anytime. Mobile devices can provide this convenience. Enterprise users require always-on access to business applications and collaborative services so that they can increase their productivity from anywhere, even when they are on the commute.
- Improved and increased broadband coverage: 3G and 4G along with WiFi, femto-cells, fixed wireless and so on are providing better connectivity for mobile devices.
- Enabling technologies: HTML5, CSS3, hypervisor for mobile devices, cloudlets and Web 4.0 will drive adoption of mobile cloud computing[4].

### IV. ADVANTAGES OF MOBILE CLOUD COMPUTING

#### Flexible

Mobile Cloud Computing is flexible as it allows accessing data from anywhere and at any time. The customer only requires an Internet connection and a device with which they can access cloud data.

#### Multiple Platform Availability

The cloud computing application introduced by the company, use in multiple platforms such as Android, IOS, and many more. The cloud can easily access and modify regardless of the platform.



### Economical

Mobile Cloud Computing eliminates the cost of hardware and it is one of the most cost-efficient methods to use and maintain. Mobile Cloud computing has very less upfront cost in the customer has to pay only for what they have used.

### Backup and recovery

The data stored with the help of mobile Cloud application can back up easily and retrieve when in need. Cloud disaster recovery is a plan which consists of storing and maintaining copies of data at several places while keeping the security measures at its peak[5].

## V. WORKING OF MOBILE CLOUD COMPUTING

On a remote data center, Mobile Cloud Applications are operated generally by a third-party, data is stored, and compute cycles are carried out. The uptime, integration, and security aspects are taken care of, by a backend, which also enables support to a multitude of access methods.

These apps can function online quite well, however, they need timely updating. These need not be permanently stored on the device but they do not always occupy any storage space on a computer or communications. Moreover, it offers the same experience as that of a desktop application, while offering the portability of a web application[4].

### 1. DEPLOYMENT CONSIDERATIONS

Mobile capabilities can be deployed in a number of different ways. One dimension is whether to deploy the mobile services using an Infrastructure as a Service (IaaS) cloud service or whether to use mobile services provided by a Platform as a Service (PaaS) cloud service. A second dimension is whether the mobile services use a private cloud deployment model, a public cloud model, or some form of hybrid cloud model.

Using IaaS cloud services means that the cloud service supplies basic resources such as compute nodes and data storage capabilities – it is the customer's responsibility to install the required software for each of the necessary service components and to configure them to work as a cohesive whole. Some of the components can be bought as off-the-shelf software, while others (such as the mobile backend applications) must be purchased or developed by the customer.

PaaS cloud services typically provide many if not all of the mobile service components as a set of cloud services. The customer selects and configures the services they need and develops code for custom components such as the mobile backend applications. The deployment of the underlying resources is largely automated by the cloud service provider, with minimal effort from the customer.

For public cloud deployment, the components are instantiated in a shared datacenter of the cloud service provider. For private cloud deployment, the components are instantiated either on-premises within the enterprise or within an isolated environment in the datacenter of a cloud service provider.

For hybrid cloud deployment, there is an element of choice of where to locate each component, either in a public cloud environment or on-premises. It is typically the case that public cloud deployment is likely to be lower cost than private cloud deployment, but may have security risks that cannot be accepted by the customer. In each case, the actual deployment topology used is driven by business factors with the choice typically governed by security and performance considerations.

Security and data protection considerations will depend on the nature of the data associated with the mobile apps and the business impact of risks such as unavailability of data or of data breaches. Generally, the greater the sensitivity of the data, the more likely it is that on-premises private cloud deployment is used. However, even if some components are deployed on-premises, it is not necessary that all components are deployed in this way[6].



## VI. CHALLENGES OF MOBILE CLOUD COMPUTING

### 1. Data Security and Privacy Issues:

In Mobile Cloud Computing the most serious concern about storing data in cloud worries every mobile cloud user. Data security is one of the major challenges faced in the field of mobile cloud computing. It is intimidating to transfer important data to the cloud because of the following data concerns that are very common in the cloud:

- Risk of data theft
- Violation of privacy rights
- Loss of physical security
- Handling of encryption and decryption keys
- Security and auditing issues of virtual machines
- Lack of standard to ensure data integrity

The privacy of data stored in the cloud belongs to its customers. In case you want to encourage the use of cloud data services, it is extremely important to standardize the concerns in cloud computing around data life cycle. This includes the standardization of the generation of data, data transfer, use and share of data, data storage and the archival and destruction of data.

### 2. Attacks at End-User Mobile Device:

It is important to protect the data from the threats of device data theft, virus and malware attacks via wireless devices and the misuse of access rights from information security point of view in the cloud. Mobile Application Security Best Practices that Companies Cannot Afford to Miss.

### 3. Information Security Issues:

Some common information security issues of cloud computing are: - System security of server and database - Networking security - User authentication - Data protection - System and storage protection.

### 4. Architecture and Cloud Service Delivery Models Issue:

Mobile cloud computing also faces some general challenges in terms of their architecture. These include the challenge of computing off-loading, security for mobile users, applications or data, improvement in efficiency rate of data access, the context-aware mobile cloud services, migration and interoperability, service level agreement and the cost and pricing. PaaS model security issues: structured query language related, application programming interface security SaaS model security issues: data security management, web application vulnerability and scanning.

### 5. Mobile Cloud Infrastructure Issues:

Due to the lack of the mobile cloud infrastructure, a variety of security attacks is possible on the cloud. These attacks again harm the security of the data of the cloud users. Some of these possible attacks from the cloud infrastructure point of view are attacks on virtual machines, vulnerabilities at the platform level, phishing, authorization and authentication and attacks from local users.

### 6. Mobile Cloud Communication Channel Issues:

The area of mobile cloud communication channel requires having a lot of improvement at various levels. The following attacks are possible at communication channel: - Access control attacks - Data integrity attacks - Attacks on authentication - Attacks on availability Low bandwidth, latency problems, availability of desired services, heterogeneity, and limited resources are other major challenges faced at the communication level[7].

## 2. LOAD BALANCING

Load balancing is the process of distributing the workload within the system to minimize the failure of the system. Load balancing is used by enterprises to organize applications and workload by allotting resources between the numbers of mobile devices connected within the network [8].

It helps users to enhance the efficiency and mitigate the cost. When the system is overloaded mobile cloud distribute the load among those mobile devices that is free and the device that is less loaded.

### 1) Offloading

Offloading scheme is the utilization of cellular network so that data can be delivered to the desired destination. Offloading technique decreases the use of unwanted data and hence the bandwidth is available for other users [9].

### 2) No-Offloading

It represents that what component is to keep on the mobile phone and what component is to migrate to the cloud server.

## VII. RELATED WORK

In this section, the work which is done by number of authors in the field of mobile cloud computing is discussed. The work proposed by different authors, the advantages and disadvantage and their outcomes are discussed in Table 1.

## 3. COMPARISON OF EXISTING RESULTS

In this section, the comparison of energy consumption and resource utilization with respect to number of resources taken from the Gill et al.

Table 1: Energy Consumption With respect to Number of resources

Number of resources	Energy consumption (KWh)		
	Normal	Good	Critical
6	49	62	62
12	80	98	98
18	101	120	121
24	130	148	149
30	148	162	163

The above figure and table represents the comparison of energy consumption rate with respect to the number of resources for different workloads named as critical, good and normal.

Table 2: Resource utilization with respect to Number of Resources

Number of resources	Resource Utilization (%)		
	Normal	Good	Critical
6	59	73	81
12	64	76	82
18	72	78	83
24	77	80	85
30	79	82	86

The above figure represents the resource utilization with respect to the number of resources for three different load conditions named as normal, good and critical. Resource utilization is defined as the ratio of total time consumed by resource to successfully execute entire workload to the total available time for resource.

The formula is written below:

$$\text{Resource utilization} = \frac{\sum_{j=1}^m \text{Total time consumed by resource to successfully execute entire workload}}{\text{TOTAL AVAILABLE TIME}}$$

Total time consumed by resource to successfully execute entire workload

TOTAL AVAILABLE TIME

From the above discussion it is concluded that MCC helps users to share resources and hence save money.

## VIII. CONCLUSION

Mobile cloud computing is a combination of Mobile computing and cloud computing, so it combines both of its advantages, Hence it will provide optimal service to the mobile users. In future 75% of smart phone users will use the Mobile cloud computing technology. In this paper, an architecture, advantages, features of mobile cloud computing have been presented. In the last section, challenges of mobile cloud computing and concept of load balancing have been presented. At last the comparison of energy consumption and resource utilization is drawn for three different loads named as critical, good and normal. We analyzed that when the workload is normal then energy consumption rate as well as resource utilization is minimum. So, in future there is a probability to reduce the energy consumption rate and resource utilization for different load by using the concept of optimization techniques with artificial intelligence.

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